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Life Satisfaction and Diet: Evidence from the Russian Longitudinal Monitoring Survey

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Keywords
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Disciplines
Health Economics

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JEL Classifications: D12, I31
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Introduction

Life satisfaction or happiness is the ultimate goal of life. Being able to understand happiness and people's quality of life is fundamental when assessing the progress of societies. There is now widespread acknowledgement that happiness and subjective well-being are essential parts of measuring quality of life alongside other social and economic dimensions. Better understanding the drivers of life satisfaction and subjective well-being will assist in government decision-making processes to improve the society's prosperity and sustainable development, including the allocation of scarce resources and the design elements of politics. People who are emotionally happier, who have more satisfying lives, and who live in happier communities, are more likely both now and later to be healthy, productive, and socially connected.

Life satisfaction and happiness research finds general patterns in the relationship between socioeconomic variables and happiness across countries and across time. Sanfey and Teksoz (2007) focus on happiness in transition context. Transition has been a difficult and painful experience for most of the citizens in the countries transitioning from socialist to market economies, but life satisfaction levels have returned to pre-transition levels after a dip in the mid-1990s. Graham (2009) explores the determinants of happiness across countries and cultures around the world. Understanding what makes people happy and satisfied may help answer some of the fundamental questions in economics. But little is known about the effects of people's diets on life satisfaction. Blanchflower et al. (2013) provided evidence for a link between the consumption of fruit and vegetables and high well-being for British citizens. One of the

limitations of their study is that the authors use cross sectional data and do not account for reverse causality.

The goal of this study is to improve our understanding of life satisfaction overall and in Russia in particular by examining the relationship between subjective well-being, life circumstances, and other important well-being outcomes; and in particular to investigate the impacts of diet on lifetime satisfaction. Studies had shown that answers concerning general happiness and life satisfaction are highly correlated (Blanchflower and Oswald 2004; Graham and Pettinato 2002). Do people with better diets report higher levels of lifestyle satisfaction? This study contributes to the existing literature on happiness by providing empirical evidence on impacts of diet on life satisfaction while correcting for reverse causality by using 1994-2005 panel data from the Russian Longitudinal Monitoring Survey (RLMS). The paper is structured as follows: The next section discusses current evidence on the relationships between diet and life satisfaction or happiness in transition economies. Then, we present the theoretical framework, RLMS data, and our empirical methodology. That is followed by discussion of the estimation results. Finally, we draw conclusions.

Life satisfaction in Russia and other transition economies

There is a large body of literature on the topics of life satisfaction and happiness. Happiness research finds general patterns in the relationship between socioeconomic variables and happiness across countries and across time. Hayo and Seifert (2003) find positive influences of education and relative income on life satisfaction, negative effect of unemployment, negative but U-shaped age effect in several Eastern European countries. Cross country differences in aggregate happiness can be explained well by variations in the unemployment rates, the degree

of political freedom, and the human development index (Hayo 2007). Easterlin et al. (2010) examines happiness in Eastern Europe from 1989 to 1998 and finds that life satisfaction followed the U-shaped pattern of GDP for those same years, but failed to recover commensurately; unhappiest respondents were the least educated and those over age 30.

Graham et al. (2004) using data from the RLMS from1995 and 2000 (two points of time), analyze the determinants of well-being in Russia. They conclude that retired people are much less happy than average, and men are happier than women (in contrast to the USA, where women are happier than men); minorities are happier than ethnic Russians; and single people are happier than married. In this study the authors are looking at the effects of happiness on income in Russia, and find that the unexplained happiness has a positive effect on future income and on health too. Not only does good health make people happy, but happiness may also have a positive effect on health. The authors explored whether happiness had causal properties on future income and other variables. Happier people earned more income and were healthier. Their results are suggestive and do not establish a clear direction of causality. Eggers et al. (2006) study the effect of regional unemployment rates on subjective well-being in post-Soviet Russia. Contrary to the findings in Europe and the USA where higher unemployment lead to lower reported life satisfaction, the Russian study finds a small but significant effect in the other direction.

Another body of literature focuses on happiness and obesity. Kropfhauber and Sunder (2013) use a dynamic model to investigate the relationship between happiness and body mass index (BMI). Their results indicate that there is an inverse U-shaped association between BMI on satisfaction in a panel of German male workers. For females the effect is not statistically significant. However, the study by Bocketman, Johansson, and Saarni (2014) finds very limited

evidence for any independent influence of obesity on subjective well-being (SWB). This implies that the adverse effects of obesity on health are the primary explanation for the observed negative relationship between obesity and SWB. Dolan, Kavetsos, and Vlaev (2013) test for causality from exercise and physical activity to life satisfaction using IV approach with the respondents' perceived benefits from exercise as instruments, and conclude that being active increases life satisfaction more for men than women.

One indicator of the subjective well-being of employees is job satisfaction. A quantitative review found that job satisfaction is a key predictor of job performance, showing that happy employees are better performers in their workplace. Erdogan et al. (2012) reviewed the research showing that individuals with higher life satisfaction are more likely to have higher levels of career satisfaction, lower turnover intentions, and higher organizational commitment. There is a dynamic relationship between happiness and other important aspects of life with effects running in both directions; human well-being also affects outcomes of interest such as health, income, and social behavior; happiness may lead to better life outcomes (Helliwell et al., 2013). There is evidence about the processes that mediate between happiness and its beneficial outcomes. For example, positive feelings bolster the immune system and lead to fewer cardiovascular problems, while anxiety and depression are linked to poorer health behaviors. Therefore, it is important to understand and account for causality when analyzing these relationships.

However, there is not much research on the impacts of diet on life satisfaction and happiness. Mujcic and Oswald (2016) investigate whether improvements in psychological well-being occur after increases in fruit and vegetable consumption using data from Australia. Results show that increased fruit and vegetable consumption is predictive of increased happiness, life satisfaction, and well-being. They were up to 0.24 life-satisfaction points (for an increase of 8

portions a day), which is equal in size to the psychological gain of moving from unemployment to employment. Improvements occurred within 24 months. Our study explores the impacts of diet, in particular, diet composition and diet diversity on life satisfaction in Russia.

Theoretical model

Following Becker and Rayo (2008) and Huffman and Rizov (2010), we develop the following theoretical model of life satisfaction production. We assume that life satisfaction is a commodity in the utility function as health, and other goods. The individual chooses to maximize utility; life satisfaction and utility are not identical. The individual has a utility function U:

$$U=U\,(S,\,C;\,O),$$

where S is life satisfaction, C is the vector of other goods and services, and O are fixed characteristics, such as age, gender, education, and socioeconomic background. The individual cannot buy life satisfaction in the marketplace. Therefore, we assume that S is not directly purchased but has to be produced by each individual according to production function, using market goods, time, and other inputs. The individual has the following life satisfaction production functions:

$$S=S\,(D,\,L,\,O;\,\varepsilon),$$

where D is food (including tobacco smoking and alcohol consumption), L is leisure, and ε is the unobservable individual characteristics that affect an individual's life satisfaction, S. Finally, the individual has a budget constraint:

$$P_D D+P_C C=W\,(T-L)+N,$$

where P_D and P_C denote the prices of food (D), and other goods and services (C), respectively; W is the wage rate per unit of time, T is the fixed time endowment (T – L=work), and N is the non-labor income. To obtain the full income budget constrain *F*, we define π_S to be the average shadow prices of producing life satisfaction S:

$$\pi_S S = W(T-L) + N - P_D D - P_C C = F.$$

The shadow price π_S depends on the prices of the goods inputs (P_D and P_C), the wage (W), and the productivity of individual production function that depends on the various individual characteristics, *O*. Therefore, the production of life satisfaction depends on personal and objective market characteristics. We assume that the individual maximizes the utility subject to life satisfaction production function and budget constraint. After substituting the optimal demand functions D^*, L^*, C^* into the life satisfaction production function, we obtain the individual's life satisfaction supply function:

$$S^* = S(D^*, L^*, C^*, O; \varepsilon).$$

Data

To investigate the relationship between subjective well-being, lifestyles, important demographic characteristics, and in particular the impacts of diet on lifetime satisfaction, we employ data from the Russia Longitudinal Monitoring Survey (RLMS) from 1994 to 2005. The RLMS is a nationally representative household survey and it samples annually the population of dwelling units as repeated cross-sections. The RLMS is coordinated by the Carolina Population Center at the University of North Carolina (http://www.cpc.unc.edu/projects/rlms). The annual samples collect data for more than 4000 households and their members who make for more than 10000

individuals surveyed each year. The collected data include a wide range of information concerning household characteristics, such as demographic composition, income, and expenditures. The RLMS is a rich data on individuals that includes employment, anthropometric measures, health status, nutrition, alcohol and cigarette consumption, and medical problems. Also one-day 24-hour recall detailed dietary data were obtained. Nutrient intake levels are reported, however, actual detailed dietary data are not available (Kozyreva et al. 2016).

The dependent variable in our model is life satisfaction. Life satisfaction is measured by *IMSATISL* variable in the RLMS. Each respondent is asked: How satisfied or unsatisfied are you with your life at present? The answer choices are: 1- Absolutely satisfied; 2- Mostly satisfied; 3- Yes and no; 4- Not very satisfied; 5- Absolutely not satisfied. In our study we transform the original RLMS variable such that 1 is dissatisfied and 5 is satisfied for ease of interpretation. Other studies have used these ordinal-scaled variables as if they were metrical, where 0 is dissatisfied, and 10 is satisfied (Katsaiti, 2012, Kropfhauber and Sunder, 2013).

The determinants of well-being include material living conditions, health (mental health is the single most important determinant of individual happiness), diet (calories, fat, protein; and diet diversity), lifestyle (alcohol, cigarettes consumption, and physical exercise), work, and family. Therefore, the independent variables in our study are socio-demographic characteristics such as age, gender, marital status, kids, education, area of residence, income, and other determinants such as labor force participation, calorie consumption, macronutrients (fat and protein) consumption, diet diversity, smoking, alcohol consumption, exercise, health problems, region, and time trend. Daily calories is a quantity measure of the diet and is collected by the 24-hour recall, while the shares of the protein and fat are quality measures of the diet, or the composition of diet. We refer from now on to the share of daily calories from fat and protein as

shares of fat and protein in diet respectively. Diet diversity is measured by a Berry index: $BI = 1 - \sum s_j^2$, where s_j is the share of expenditures on food group j in total consumption expenditure (Thiele and Weiss, 2003; Herzfeld, et al. 2014). Higher values indicate a more diverse diet where diet component foods are consumed in similar shares. Alcohol consumption and smoking are defined as dummy variables equal to 1 if the individual consumes alcohol and smokes cigarettes during the last 30 days respectively. Exercise is a scale variable equal to 1 if the individual does not exercise at all, equal to 2 if the individual's exercise is light, and equal to 3 if the individual's exercise is medium to high. The definitions, means, and standard deviation for all variables used in our analysis are presented in Table 1.

Figure 1 presents the distribution of life satisfaction levels among Russian people for the period 1994 to 2005. The share of the people who were absolutely unsatisfied and not very satisfied increased from 1994 to 1998, while the shares of the people who are satisfied decreased over that period. Since 2000, the shares of the mostly satisfied, absolutely satisfied, and "yes and no" satisfied started increasing. The relationship between life satisfaction and marital status, gender, employment, and area of residence from 1994 to 2005 in Russia, generally, has a J-shape. Average life satisfaction levels tend to fall during the early years of transition (from 1994 to 1998, the year of the financial crisis in Russia), but returned to the pre-transition levels in 2000, and in 2005 were higher than in 1994. Married individuals report higher levels of life satisfaction compared to non-married. Life satisfaction levels are higher for men than women. In addition, employed people have higher levels of life satisfaction compared to the unemployed. Life satisfaction of individuals living in urban areas is higher than those who live in rural areas. Life satisfaction shows a U-shaped pattern when graphed against age in Russia, the decline

continues into 40s and 50s, and recovers thereafter (see Figure 2). This finding is consistent with the U-shaped pattern in other countries.

The data also indicate that the highest values for life satisfaction are for individuals with university or higher education, with the lowest values for people with the least education (education below grade 8). Individuals who do not exercise have the lowest values of the happiness index. People who consume alcohol report slightly higher level of life satisfaction, while there is not too much difference between the satisfaction of smokers and nonsmokers in Russia, with the exception of the last few years when the smokers report slightly higher level of happiness compared to the nonsmokers. Figures 3-5 present the relationship between life satisfaction and protein, fat, and diet diversity by quintiles of the respective distributions in Russia. The relationships follow the patterns of J-shaped curve, showing the decline in life satisfaction during early years of the transition to a market economy, and steady increase for the rest of the period analyzed. Individuals in the last quintile (or those with the highest consumption) of the consumption distributions report the highest values of life satisfaction, while the individuals in the 1st quintile (with the least consumption) report the lowest values of life satisfaction in Russia. In 2005, the happiness score has very similar values for all but the 1st quintile of the protein consumption and diet diversity distributions, which has the lowest value of happiness in the respective distributions.

Empirical model

Following our theoretical model, we estimate the following econometric equation:

$$S_{it} = \alpha_0 + \alpha_1 D + \alpha_2 C + \alpha_3 A + \alpha_4 E + \alpha_5 O + v_i + \eta_{it} \quad (1)$$

where *S* is an indicator of satisfaction/happiness. *D* is diet (composition), *C*-cigarette smoking, *A*-alcohol consumption, *E*-exercise. *O* is a vector of exogenous explanatory variables, including age, age squared, education (the tree categories), married, children 7 (age<7), children 18 (8<=age<18), bad health (an indicator of self-assessed health status), regions, service or manufacturing sector employment, regional characteristics (unemployment rate, inflation, GRP per capita, GRP growth), v_i are panel data random effects, which are independent and identically distributed $N(0, \alpha_v^2)$, and η_{it} is the disturbance term.

The choice between OLS and ordered probit regression analysis rests on whether the categories of the life satisfaction are considered cardinal or ordinal. Economists typically consider these well–being scores as ordinal and have mainly opted for the ordered probit analysis. Psychologists and sociologists interpret happiness categories as cardinal and therefore use OLS. Ferrer-i-carbonel and Frijters (2004) survey and test both empirical literatures to conclude that assuming ordinality or cardinality in life satisfaction surveys makes little difference in studies where the dependent variable is measured at a single point in time. To estimate the econometric model of life satisfaction in equation 1, we employ two approaches. First, we consider the categories of life satisfaction ordinal and to account for the panel data, we estimate random effects ordered logistic model. Second, we consider the categories of life satisfaction cardinal, and account for endogeneity resulting from reverse causality from dependent and independent variables; we employ the panel data Generalized Methods of Moments (GMM) estimator.

Therefore, we estimate our model first using the *xtologit* command in STATA 13 that fits random-effects ordered logistic models. Ordered logistic models are used to estimate relationships between an ordinal dependent variable and a set of independent variables. The

actual values taken on by the dependent variable are irrelevant, although larger values are assumed to correspond to "higher" outcomes. The conditional distribution of the dependent variable given the random effects is assumed to be multinomial with success probability determined by the logistic cumulative distribution function.

Not many studies have addressed the issue of endogeneity that could be resulting from reverse causality from dependent and independent variables in the context analyzed. Random measurement error in the endogenous variables such as in the 24-hour recall diet will also be eliminated by the use of predicted values. Considering potential endogeneity problems with several of our explanatory variable (food choices) and reverse causality issues, we also estimate our models by a panel Generalized Method of Moments (GMM) estimator. Blundell and Bond (1998) developed a "system" GMM extending the first-difference GMM estimator of Arellano and Bond (1991). It uses both the first-difference and level information and allows the variables in levels to be instrumented with suitable lags of their own first differences. We use the *xtabond2* (with two-step option) command in STATA to implement the system GMM estimator. In our estimations we treat income, diet (consumption of macronutrients and diversity), smoking and drinking choices, lifestyle (exercise) choices, health status, education, employment status, marital status, household size as predetermined; we consider these variables as potentially affected by the individual's level of happiness. Age, gender, regional economic characteristics, and time dummies are used as exogenous instruments. Modifying the assumptions about individual variables in terms of endogenous or predetermined does not significantly change the results reported.

Results

Table 2 shows the results from the estimated econometric models. The dependent variable is life satisfaction and the first column of the table shows the variables in the model. The second column of Table 2 presents the estimated coefficients from the random effects ordered logistic regression. The estimated coefficients of age and the squared term of age point to a convex or U-shaped relationship between life satisfaction and age. Having university or higher education and having higher income make you more satisfied with life in Russia. The estimated coefficient of household size suggests that individuals living in larger households have higher levels of life satisfaction, while having young children, age 7 and under, decreases individual life satisfaction. The coefficients of the calories, fat, and protein consumption, and consuming a diverse diet are positive and statistically significant, indicating that these determinants positively affect life satisfaction levels. Males are more satisfied with their lives; being married for both genders increases life satisfaction levels in Russia. The coefficient on smoking is negative and statistically significant, indicating a negative correlation with life satisfaction, while consuming alcohol has a positive and statistically significant, at the 0.05 statistical level, effect on life satisfaction. Being in poor health and living in rural areas decrease an individual's life satisfaction. Having a job and living in a region with high GDP per capita increase the individual's life satisfaction.

The third column of Table 2 presents the estimated coefficients from the panel data GMM estimation. The coefficients confirm the reported effects from the random effects ordered logistic regression, with the exception of a few variables (age, education, smoking, diet diversity), which are no longer statistically significant. These results suggest some potential reverse causality issues where life satisfaction might affect education, smoking, and food

consumption choices. The difference in results might also indicate that treating the life satisfaction measure as ordinal or cardinal is of some significance. The magnitudes of the effects are small. Life satisfaction will be increased by 0.015, 0.01, and 0.013 due to a 10% increase in caloric consumption, fat, and protein consumption respectively; these increases represent less than one percent of the life satisfaction mean. The estimated coefficients on the East and West Siberia regional dummies point to negative and statistically significant effect, suggesting that the people living in these regions have lower life satisfaction levels relative to the people living in Moscow areas. All of the coefficients of the year dummies are also statistically significant, negative for the first three years (1995, 1996, 1998) and positive from 2000 to 2005, which suggest increasing life satisfaction levels over the years.

Conclusions

This paper provides empirical evidence on impacts of diet and lifestyles (smoking, drinking, and exercise) on life satisfaction in Russia using 1995-2005 data from the Russian Longitudinal Monitoring Survey (RLMS). Results suggest that calories, fat, and protein consumption, and a more diverse diet have a positive and statistically significant effect on life satisfaction levels of the Russian people. In addition, living in a region with higher per capita income increases life satisfaction of the citizens. While living in a rural area, having health problems, and having young children affect individual life satisfaction in Russia in a negative and statistically significantly way.

Better understanding of the drivers of subjective well-being in Russia will assist in government decision-making processes, including the allocation of scarce resources and the

design elements of politics. An effort is needed to improve the life satisfaction of vulnerable groups, such as low-income, least-educated individuals, and rural residents in Russia.

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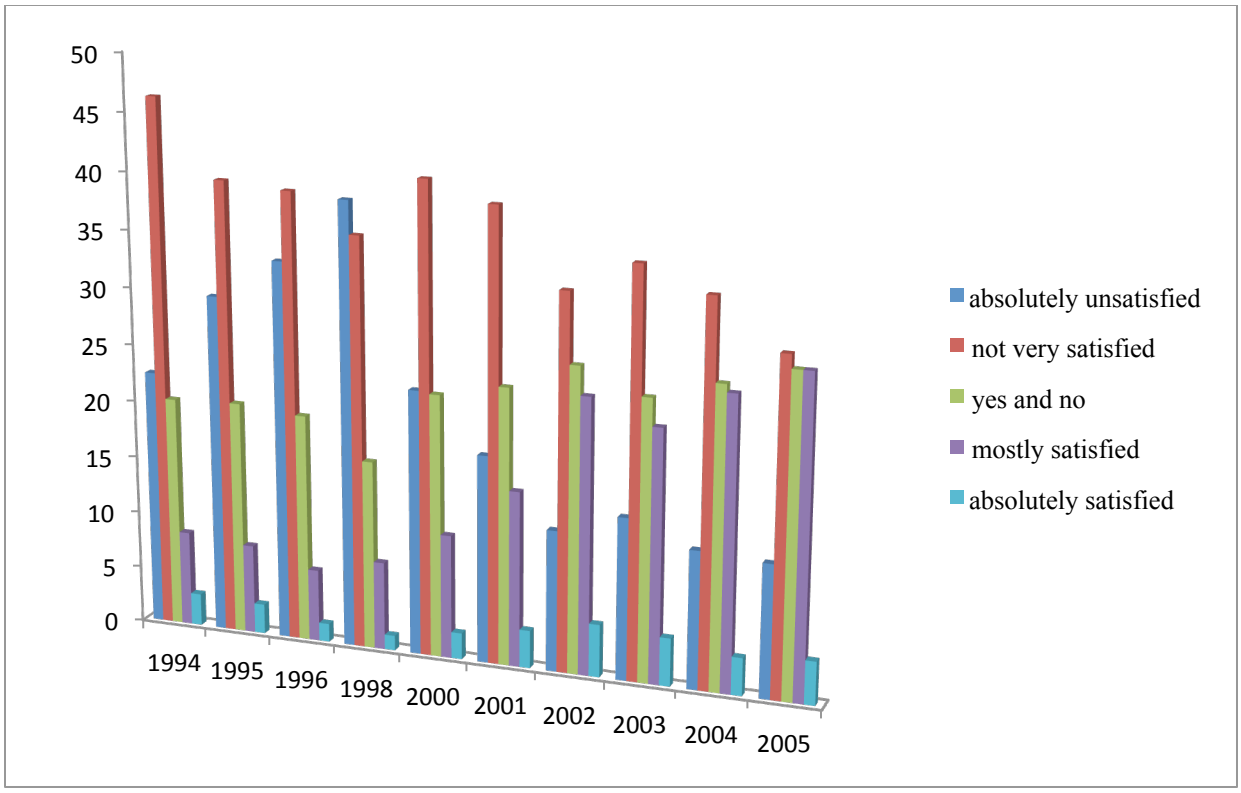

Figure 1: Distribution of life satisfaction levels among Russian people, 1994-2005, (%).

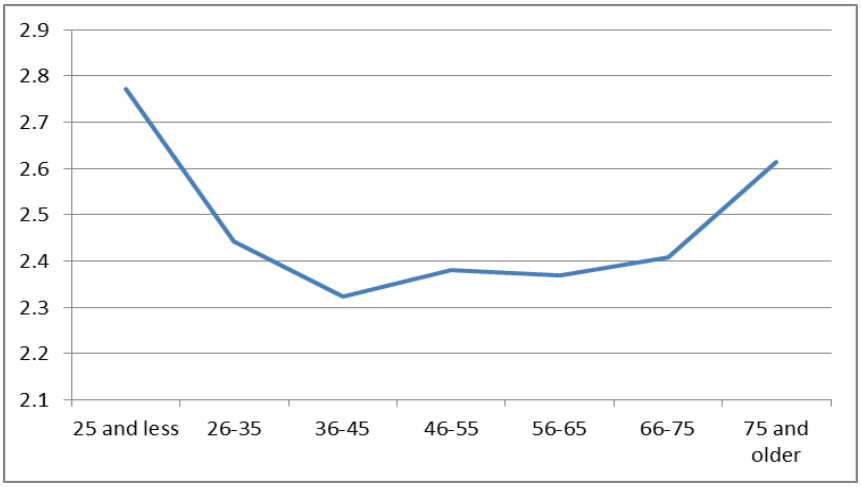

Figure 2: Life satisfaction and age in Russia

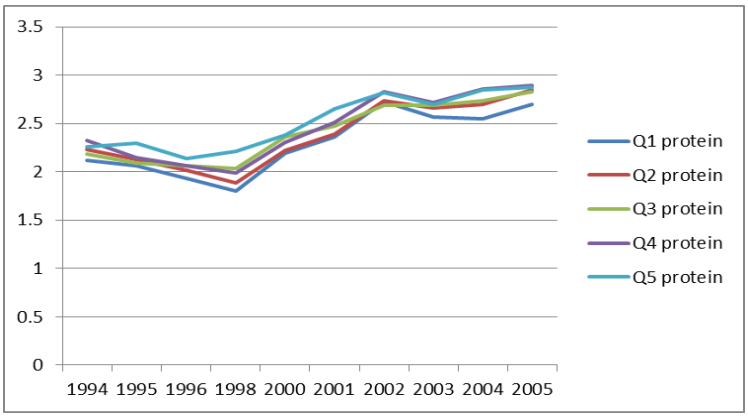

Figure 3: Life satisfaction and protein consumption in Russia (1994-2005)

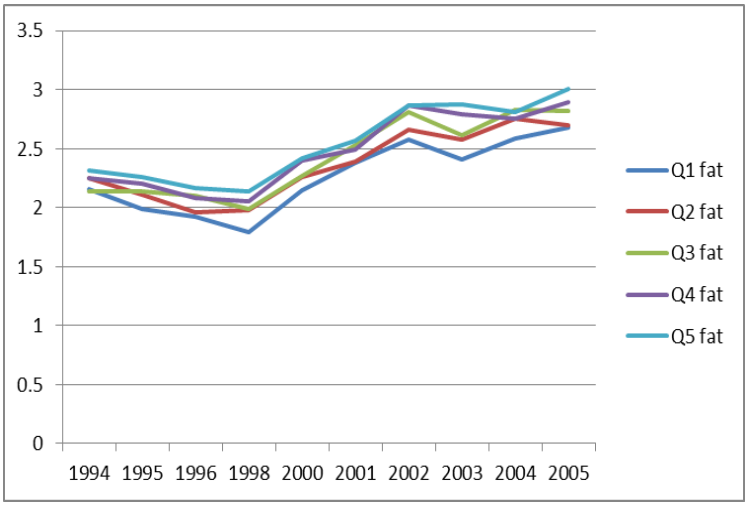

Figure 4: Life satisfaction and fat consumption in Russia (1994-2005)

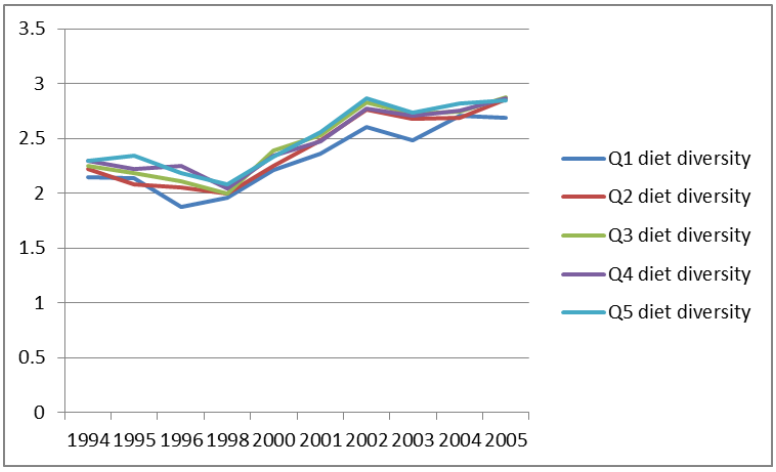

Figure 5: Life satisfaction and diet diversity in Russia (1994-2005)

Table 1. Descriptive characteristics of the variables used in the analysis

Variable (definition)	Full sample	
Dependent variable	Mean	SD
Life Satisfaction	2.43	1.08
Explanatory variable-Log numbers		
Calories (total calories consumed per day) in logarithm	7.54	0.49
Fat (share in % of daily calories from fat) in logarithm	3.44	0.34
Protein (% of daily calories from protein) in logarithm	2.59	0.25
HH_size (# members)	1.40	0.36
HH_income (monthly income in Rubles)	7.21	4.46
GRP per capita (real GRP)	10.37	0.39
Explanatory variables		
Age	46.79	15.88
Age_squared	2441.18	1547.91
Food diversity (Transformed Berry Index =ln[BI/(1-BI)])[1]	0.79	1.45
Exercise (scale 1-3, 1=not at all, 2=light, 3=medium to high)	1.22	0.57
Explanatory variables-Dummy		
Primary school (has primary education)	0.35	0.48
High school (has high school education)	0.50	0.50
University (has university education)	0.15	0.36
Kidsage7 (presence of kids up to 7 years old)	0.19	0.39
Kidsage17 (presence of kids age 8 to 17 years old)	0.40	0.49
Work (is employed)	0.61	0.49
Gender (is male=1)	0.36	0.48
Married (is married=1)	0.69	0.46
Smoker (if the individual smokes)	0.26	0.44
Drinker (if the individual consumes alcohol)	0.52	0.50
Health (having health problems last month=1)	0.42	0.49
Moscow-St.Petersburg (if individual resides in Moscow-St.Petersburg region)	0.01	0.09
North and Northwest (if individual resides in North and Northwest region)	0.06	0.23
Central (if individual resides in Central region)	0.20	0.40
Volga region (if individual resides in Volga region)	0.24	0.43
North Caucasus (if individual resides in North Caucasus region)	0.15	0.36
Ural region (if individual resides in Ural region)	0.17	0.38
West Siberia (if individual resides in West Siberia region)	0.09	0.28
East Siberia (if individual resides in East Siberia region)	0.08	0.27

Table 2. Coefficient Estimates (dependent variable-life satisfaction)

Variable	Random Effects ordered logit Coefficient (S.E.)	Panel GMM Coefficient (S.E.)
Age	-0.1105 (0.0091)***	-0.0159 (0.0144)
Age_squared	0.0011 (0.0001)***	0.0001 (0.0001)
High school	0.0634 (0.0504)	-0.099 (0.2017)
University	0.1388 (0.0758)*	-0.2420 (0.3692)
HH_size	0.1972 (0.0829)**	0.5710 (0.2704)**
Kidsage7	-0.1870 (0.0537)***	-0.5372 (0.1536)***
Kidsage17	-0.0730 (0.0439)*	-0.2050 (0.1369)
HH_income	0.0398 (0.0041)***	0.0102 (0.0026)***
Calories	0.0901 (0.0424)**	0.1510 (0.0578)**
Fat	0.2193 (0.0469)***	0.0967 (0.0307)***
Protein	0.2238 (0.0584)***	0.1320 (0.0493)**
Food diversity	0.0199 (0.0108)*	0.0056 (0.0058)
Gender	0.3128 (0.0639)***	0.0082 (0.0626)
Married	0.3538 (0.0560)***	0.2492 (0.1139)**
Work	0.2237 (0.0456)***	0.1095 (0.0460)**
Smoker	-0.1734 (0.0589)***	-0.0142 (0.0754)
Drinker	0.0733 (0.0341)**	0.0464 (0.0246)*
Exercise	0.1064 (0.0263)***	0.0269 (0.0191)
Health problems	-0.2268 (0.0332)***	-0.0133 (0.0220)
Rural	-0.1387 (0.0617)**	-0.1130 (0.0488)**
Real GRPC	0.2812 (0.0898)***	0.0102 (0.0639)
North and Northwest	0.2301 (0.2979)	-0.1103 (0.1414)
Central	0.1859 (0.2819)	-0.1897 (0.1410)
Volga region	0.1915 (0.2812)	-0.2036 (0.1477)
North Caucasus	0.3464 (0.2913)	-0.1607 (0.1753)
Ural region	0.1495 (0.2813)	-0.2017 (0.1406)
West Siberia	-0.0882 (0.2935)	-0.3488 (0.1549)**
East Siberia	0.0257 (0.2860)	-0.2593 (0.1378)*
Year 1995	-0.2541 (0.691)***	-0.0732 (0.0350)**
Year 1996	-0.4718 (0.0735)***	-0.2590 (0.0415)***
Year 1998	-0.3296 (0.0708) ***	-0.1684 (0.0362) ***
Year 2000	0.3853 (0.0664) ***	0.1306 (0.0367) ***
Year 2001	0.7283 (0.0703) ***	0.2965 (0.0400) ***
Year 2002	1.3463 (0.0714) ***	0.5985 (0.0426) ***
Year 2003	1.0934 (0.0738) ***	0.5045 (0.0449) ***
Year 2004	1.2098 (0.0795) ***	0.5770 (0.0517) ***
Year 2005	1.3439 (0.0817) ***	0.6540 (0.0553) ***
No observations	22,625	22,625